

CLAIMS

1. An apparatus for planarizing a semiconductor substrate, comprising a platen having a generally flat engaging surface to at least partially sealably engage a planarizing medium, the engaging surface having at least one vacuum aperture sized and shaped to be coupled to a vacuum source, the planarizing medium being drawn against the engaging surface of the platen when the vacuum source applies a vacuum to the vacuum aperture.
2. The apparatus of claim 1, further comprising a carrier proximate to the platen, one of the carrier and the platen being movable relative to the other of the carrier and the platen to remove material from the semiconductor substrate when the semiconductor substrate is positioned therebetween.
3. The apparatus of claim 1, further comprising the planarizing medium, the planarizing medium including a polishing pad having a generally non-porous surface that forms an at least partially gas-tight seal with the engaging surface of the platen when the vacuum source draws the planarizing medium against the platen.
4. The apparatus of claim 3 wherein the polishing pad comprises polyurethane.
5. The apparatus of claim 3 wherein the polishing pad comprises glass.
6. The apparatus of claim 1, further comprising the planarizing medium, the planarizing medium including a polishing pad and a pad support, the pad support having first and second surfaces, the first surface of the pad support being attached to the polishing pad, the second surface of the pad support being generally

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non-porous to form an at least partially gas-tight seal with the engaging surface of the platen.

7. The apparatus of claim 1 wherein the planarizing medium is elongated between a first end and a second end, further comprising a supply device coupleable to the first end of the planarizing medium and a take-up device coupleable to the second end of the planarizing medium to draw the planarizing medium from the supply device across the platen.

8. The apparatus of claim 7 wherein the supply device includes a first roller and the take-up device includes a second roller, at least one of the first and second rollers being rotatable relative to the platen to draw the planarizing medium across the platen.

9. The apparatus of claim 1, further comprising a liquid trap in fluid communication with the vacuum source and the vacuum aperture and positioned between the vacuum source and the vacuum aperture to at least restrict motion of liquid between the platen and the vacuum source.

10. The apparatus of claim 9 wherein the liquid trap includes a passageway connected between the vacuum aperture and the vacuum source, the passageway having at least one bend to collect liquid from fluid drawn through the vacuum aperture.

11. The apparatus of claim 1 wherein the vacuum aperture is one of a plurality of vacuum apertures in the engaging surface of the platen.

12. The apparatus of claim 1 wherein the vacuum aperture has a generally circular cross-sectional shape.

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13. The apparatus of claim 1 wherein the vacuum aperture is elongated.

14. The apparatus of claim 1 wherein the planarizing medium has a first surface, a second surface opposite the first surface, and an intermediate surface between the first and second surfaces and the platen has a rim projecting from the engaging surface, the rim being adjacent to the intermediate surface of the planarizing medium to restrict lateral movement of the planarizing medium relative to the platen.

15. The apparatus of claim 1, further comprising a stop connected to the platen and releasably engageable with the planarizing medium to restrict lateral motion of the planarizing medium relative to the platen.

16. The apparatus of claim 1 wherein the vacuum source is mounted to the platen.

17. The apparatus of claim 16 wherein the platen has a generally circular planform shape and the vacuum source is mounted toward an edge of the platen, further comprising a counterweight mounted toward the edge of the platen opposite the vacuum source.

18. The apparatus of claim 1 wherein the vacuum source is spaced apart from platen.

19. The apparatus of claim 1 wherein the engaging surface of the platen is positioned beneath the planarizing medium when the engaging surface at least partially sealably engages the planarizing medium.

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20. An apparatus for planarizing a semiconductor substrate, comprising:

a support;

a platen coupled to the support and having a generally flat engaging surface to at least partially, sealably engage a planarizing medium; and

vacuum means in fluid communication with the platen for drawing the planarizing medium against the engaging surface of the platen.

21. The apparatus of claim 20 wherein the vacuum means includes a vacuum aperture in a surface of the platen and a vacuum source coupled to the vacuum aperture to draw gas toward the vacuum source and draw the planarizing medium against the platen.

22. The apparatus of claim 20 wherein the vacuum means includes a vacuum pump mounted to the platen and a power supply mounted to the platen and connected to the vacuum pump to power the vacuum pump when the platen moves relative to the support.

23. The apparatus of claim 22 wherein the power supply includes a battery.

24. The apparatus of claim 20 wherein the vacuum means includes a vacuum aperture in the engaging surface of the platen, a vacuum source spaced apart from the platen, and a conduit connected between the vacuum aperture and the vacuum source.

25. The apparatus of claim 24 wherein the platen is movable relative to the support and the conduit includes a first portion coupled to the platen and a second portion coupled to the vacuum source and sealed to the first portion, the first and second portions of the conduit being movable relative to each other to allow the

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platen to move relative to the support while an at least partially gas-tight seal is maintained between the first and second portions of the conduit.

26. The apparatus of claim 20 wherein the engaging surface of the platen is positioned beneath the planarizing medium when the engaging surface at least partially sealably engages the planarizing medium.

27. An apparatus for planarizing a semiconductor substrate, comprising:

a support;

a generally circular platen coupled to the support, the platen having an engaging surface to at least partially, sealably engage a planarizing medium, the engaging surface having a plurality of vacuum apertures, the platen further having a stop releasably coupleable to the planarizing medium to at least restrict motion of the planarizing medium relative to the platen;

a vacuum source attached to the platen and coupled to the plurality of vacuum apertures to draw the planarizing medium against the engaging surface of the platen; and

a power supply attached to the platen and coupled to the vacuum source to supply power to the vacuum source while the platen moves relative to the support.

28. The apparatus of claim 27 wherein the power supply is attached to the platen at a circumferential position selected to balance the platen when the platen rotates relative to the support.

29. The apparatus of claim 27, further comprising a liquid trap connected between the vacuum source and the vacuum aperture to at least restrict motion of liquid between the platen and the vacuum source.

30. The apparatus of claim 27 wherein the liquid trap includes a passageway connected between the vacuum apertures and the vacuum source, the passageway having at least one bend to collect liquid from fluid drawn through the vacuum apertures.

31. The apparatus of claim 27 wherein at least one of the vacuum apertures includes an arcuate opening in the engaging surface of the platen.

32. The apparatus of claim 27 wherein the planarizing medium has a first threaded portion, the stop includes a second threaded portion of the platen, the second threaded portion being sized and shaped to releasably engage the first threaded portion of the planarizing medium and restrict lateral and vertical motion of the planarizing medium relative to the platen.

33. The apparatus of claim 27 wherein the planarizing medium has an aperture and the platen has a tab member, the tab member being sized and shaped to be removably received in the aperture and restrict lateral and vertical motion of the planarizing medium relative to the platen.

34. The apparatus of claim 27 wherein the planarizing medium has an upper surface and a lower surface opposite the upper surface, and the engaging surface of the platen at least partially sealably engages the lower surface of the planarizing medium.

35. An apparatus for planarizing a semiconductor substrate, comprising:

a platen having a generally flat engaging surface to engage an elongated planarizing medium, the engaging surface having at least one vacuum aperture;

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a positioning device proximate to the platen and coupleable to the planarizing medium to move the planarizing medium across the engaging surface of the platen; and

a vacuum source coupled to the vacuum aperture to draw the planarizing medium against the engaging surface of the platen.

36. The apparatus of claim 35, further comprising the planarizing medium, the planarizing medium having a generally non-porous surface to form an at least partially gas-tight seal with the engaging surface of the platen when the vacuum source draws the planarizing medium against the platen.

37. The apparatus of claim 35, further comprising a carrier proximate to the platen to remove material from the semiconductor substrate when the substrate is positioned between the carrier and the platen and one of the carrier and the platen is moved relative to the other of the carrier and the platen.

38. The apparatus of claim 35 wherein the pad positioning device includes a first roller connected to one end of the planarizing medium and a second roller connected to an opposite end of the planarizing medium, at least one of the first and second rollers being rotatable relative to the platen to move the planarizing medium across the platen.

39. The apparatus of claim 35, further comprising a liquid trap connected between the vacuum source and the vacuum aperture to at least restrict motion of liquid between the platen and the vacuum source.

40. The apparatus of claim 35 wherein the liquid trap includes a channel connected between the vacuum aperture and the vacuum source, the channel having at least one bend to collect liquid from fluid drawn through the vacuum aperture.

41. The apparatus of claim 35 wherein the vacuum source is spaced apart from platen.

42. The apparatus of claim 35 wherein the planarizing medium has an upper surface and a lower surface opposite the upper surface, and the engaging surface of the platen at least partially sealably engages the lower surface of the planarizing medium.

43. An apparatus for planarizing a semiconductor substrate, comprising a platen having a generally flat engaging surface to engage a planarizing medium, the platen including a conductive element coupleable to a signal source to produce an attractive force between the planarizing medium and the platen to draw the planarizing medium toward the platen.

44. The apparatus of claim 43 wherein the conductive element is a first conductive element, further comprising the planarizing medium, the planarizing medium having a second conductive element.

45. The apparatus of claim 44 wherein the planarizing medium includes a polishing pad having a first surface facing toward the platen and a second surface opposite the first surface, the second conductive element including a conductive plate adjacent the first surface.

46. The apparatus of claim 44 wherein the planarizing medium includes a polishing pad having a first surface and a second surface opposite the first surface, the second conductive element including a conductive particle between the first and second surfaces.

47. The apparatus of claim 44 wherein the second conductive element includes a ferrous material.

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48. The apparatus of claim 44 wherein the second conductive element is adhesively bonded to the planarizing medium.

49. The apparatus of claim 43 wherein the conductive element is coupled to a voltage source.

50. The apparatus of claim 43 wherein the conductive element includes a permanent magnet.

51. The apparatus of claim 43 wherein the conductive element includes an electromagnet.

52. A planarizing medium for a planarizing machine, comprising:
a polishing pad having a planarizing surface and a support surface opposite the planarizing surface; and
a pad support having first and second opposite surfaces, the first surface being attached to the support surface of the polishing pad, the pad support being releasably attached to the planarizing machine.

53. The planarizing medium of claim 52 wherein the polishing pad includes a generally flexible material and the pad support includes a generally rigid material.

54. The planarizing medium of claim 52 wherein the second surface of the pad support is generally non-porous.

55. The planarizing medium of claim 52 wherein the pad support includes a first thread to engage a second thread of the planarizing machine and secure the pad support to the planarizing machine.

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56. The planarizing medium of claim 52 wherein the polishing pad is removably attached to the pad support.

57. A method for removably attaching a planarizing medium to a platen of a planarizing machine, comprising:

positioning the planarizing medium adjacent the platen; and

applying a vacuum to an attachment surface of the planarizing medium to draw the planarizing medium against the platen.

58. The method of claim 57, further comprising forming an at least partially gas-tight seal between the planarizing medium and the platen.

59. The method of claim 57 wherein the planarizing medium includes a polishing pad having first and second surfaces and a pad support having first and second surfaces, the attachment surface of the planarizing medium comprising the second surface of the pad support, the method further comprising attaching the first surface of the polishing pad to the first surface of the pad support.

60. The method of claim 59 wherein the act of attaching the first surface of the polishing pad to the first surface of the pad support includes positioning an adhesive between the first surface of the polishing pad and the first surface of the pad support.

61. The method of claim 57 wherein the act of applying a vacuum to the planarizing medium includes drawing a fluid through at least one vacuum aperture in a portion of the platen adjacent the pad assembly.

62. The method of claim 61 wherein the fluid includes a liquid and a gas, further comprising removing the liquid from the fluid.

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63. The method of claim 57 wherein the planarizing medium has a planarizing surface opposite the attachment surface and an intermediate surface between the planarizing surface and the attachment surface, the method further comprising engaging the intermediate surface of the planarizing medium to at least restrict lateral movement of the planarizing medium relative to the platen.

64. The method of claim 57, further comprising engaging a releasable stop with the planarizing medium to releasably secure the planarizing medium to the platen.

65. The method of claim 60 wherein the stop includes a tab member attached to one of the planarizing medium and the platen, a tab aperture in the other of the planarizing medium and the platen, and the act of engaging the stop includes inserting the tab member into the tab aperture. A

66. The method of claim 64 wherein the stop includes a first threaded portion of the planarizing medium and a corresponding second threaded portion of the platen and the act of engaging the stop includes engaging the first threaded portion with the second threaded portion.

67. The method of claim 57, further comprising:
releasing the vacuum;
moving the planarizing medium laterally relative to the platen; and
applying the vacuum to draw the planarizing medium back against the platen.

68. The method of claim 57, further comprising:
attaching a vacuum source to the platen; and
attaching a counterweight to the platen to balance the vacuum source.

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69. The method of claim 57 wherein the act of attaching a counterweight includes attaching a power supply to the platen, further comprising coupling the power supply to the vacuum source.

70. The method of claim 57 wherein the attachment surface of the planarizing medium is a lower surface and the act of applying a vacuum includes applying a vacuum to the lower surface of the planarizing medium to draw the lower surface of the planarizing medium against an upper surface of the platen.

71. A method for planarizing a semiconductor substrate with a planarizing machine, the planarizing machine having a platen, a first planarizing medium, and a carrier to engage the semiconductor substrate with the first planarizing medium, the method comprising:

positioning the first planarizing medium adjacent the platen;

applying a vacuum to a plurality of apertures in a surface of the platen to form an at least partially gas-tight seal between the first planarizing medium and the platen;

moving at least one of the platen and the carrier relative to the other of the platen and the carrier to remove material from the semiconductor substrate;

releasing the vacuum; and

removing the first planarizing medium from the platen and positioning a second planarizing medium adjacent the platen.

72. The method of claim 71 wherein the first planarizing medium includes a polishing pad having first and second surfaces and a pad support having first and second surfaces, further comprising attaching the first surface of the polishing pad to the first surface of the pad support with an adhesive.

73. The method of claim 71, further comprising removing liquid from a fluid drawn through the vacuum apertures.

74. The method of claim 71 wherein the planarizing medium has an attachment surface adjacent the platen, a planarizing surface opposite the attachment surface, and an intermediate surface between the planarizing surface and the attachment surface, the method further comprising engaging the intermediate surface of the planarizing medium with the platen to at least restrict lateral movement of the planarizing medium relative to the platen.

75. The method of claim 71 wherein the intermediate surface has a first threaded portion and the platen has a second threaded portion, and the act of engaging the intermediate surface includes threadably engaging the first threaded portion with the second threaded portion.

76. The method of claim 71 wherein the act of applying a vacuum includes applying a vacuum to a lower surface of the planarizing medium to form an at least partially gas-tight seal between the lower surface of the planarizing medium and an upper surface of the platen.

77. A method for releasably attaching a planarizing medium to a platen of a planarizing machine, the planarizing machine having carrier that engages a surface of a semiconductor substrate with a surface of the planarizing medium, the planarizing machine further having a positioning device connected to opposite ends of the planarizing medium to move the planarizing medium across the platen, the method comprising:

positioning the planarizing medium adjacent the platen; and

resisting lateral motion of a portion of the planarizing medium relative to the platen by applying a vacuum to the portion of the planarizing medium, the portion of the planarizing medium being laterally spaced apart from the carrier when the carrier engages the semiconductor substrate with the planarizing medium.

78. The method of claim 77, further comprising forming an at least partially gas-tight seal between the planarizing medium and the platen.

79. The method of claim 77, further comprising:
releasing the vacuum;
moving the planarizing medium laterally relative to the platen; and
re-applying the vacuum to draw the planarizing medium back against the platen.

80. The method of claim 77 wherein the act of applying a vacuum to the planarizing medium includes drawing fluid through at least one vacuum aperture in a portion of the platen adjacent the planarizing medium.

81. The method of claim 80 wherein the fluid includes a gas and a liquid, further comprising removing liquid from the fluid.

82. The method of claim 77 wherein the positioning device includes a supply device connected to a first end of the planarizing medium and a take-up device connected to a second end of the planarizing medium opposite the first end of the planarizing medium, further comprising activating at least one of the supply device and the take-up device to move the planarizing medium laterally across the platen.

83. The method of claim 77 wherein the planarizing medium is elongated between a first end and a second end and the pad positioning device includes a supply roller attached to the first end of the planarizing medium and a take-up roller attached to the second end of the planarizing medium, the method further comprising rotating the take-up roller to draw the planarizing medium from the supply roller across the platen.

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84. The method of claim 83, further comprising rotating the supply roller.

85. The method of claim 77 wherein the portion of the planarizing medium includes a lower surface of the planarizing medium and the act of resisting lateral motion of the portion includes drawing the lower surface of the planarizing medium against an upper surface of the platen.

86. A method for planarizing a semiconductor substrate with a planarizing machine, the planarizing machine having a platen, a first planarizing medium adjacent the platen, and a carrier movable relative to the platen, the method comprising:

applying a vacuum to a plurality of apertures in a surface of the platen to form an at least partially gas-tight seal between the first planarizing medium and the platen;

moving at least one of the platen and the carrier relative to the other of the platen and the carrier to remove material from the semiconductor substrate;

releasing the vacuum; and

replacing the first planarizing medium with a second planarizing medium.

87. The method of claim 86 wherein the planarizing machine includes a stop to releasably lock the planarizing medium to the platen, further comprising releasing the stop before removing the first planarizing medium from the platen.

88. The method of claim 86, further comprising removing liquid from a fluid drawn through the vacuum apertures.

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89. A method for removably attaching a planarizing medium to a platen of a planarizing machine, comprising applying a signal to the platen that produces an attractive force between the platen and the planarizing medium.

90. The method of claim 89, further comprising positioning the platen adjacent to the planarizing medium.

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91. The method of claim 89 wherein applying the signal includes passing an electrical current through the platen and attracting the planarizing medium via an electromagnetic force.

92. The method of claim 89 wherein the planarizing medium includes a polishing pad and a support member and applying a signal includes applying a signal that produces an attractive force between the platen and the support member.

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93. The method of claim 89 wherein the planarizing medium includes a polishing pad having conductive particles and applying a signal includes applying a signal that produces an attractive force between the platen and the conductive particles.

94. The method of claim 89 wherein applying a signal includes applying a voltage to the platen that causes an electrostatic attraction between the platen and the planarizing medium.

95. A method for conditioning a polishing pad of a planarizing machine, comprising:

attaching the polishing pad to a generally rigid pad support;
releasably supporting the pad support to position the polishing pad adjacent an end effector; and

engaging a planarizing surface of the polishing pad with the end effector to condition the polishing pad.

96. The method of claim 95 wherein attaching the polishing pad includes releasably attaching the polishing pad.

97. The method of claim 95 wherein supporting the pad support and the polishing pad includes applying a vacuum to the pad support.

98. The method of claim 95 wherein supporting the pad support and the polishing pad includes engaging a threaded portion of the pad support with a corresponding threaded portion of a support jig.

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